

CLAIMS

What is claimed is:

1. A therapeutic method for treating a medical condition in a patient, said method comprising:

diagnosing a medical condition of a patient;

administering an electric nerve stimulation (ENS) therapy to a first body location of said patient; and

administering a magnetic stimulation (MS) therapy to a second body location of said patient.

2. The method of claim 1 wherein said electrical nerve stimulation (ENS) therapy comprises vagus nerve stimulation (VNS).
3. The method of claim 1 wherein said electrical nerve stimulation (ENS) therapy comprises cranial nerve stimulation (CNS).
4. The method of claim 1 wherein said MS therapy comprises transcranial magnetic stimulation (TMS).
5. The method of claim 1 wherein said medical condition is a neuropsychiatric disorder.
6. The method of claim 1 wherein said step of administering a MS therapy comprises:

applying a magnetic field to a pre-selected synaptic region of the brain of the patient;

monitoring a physiological response associated with said application of said magnetic field; and

selectively adapting at least one parameter of said magnetic field in response to said monitored physiological response.

7. The method of claim 1 wherein said first body location comprises a first set of nerves in the brain and said second body location comprises a second set of nerves in the brain.
8. The method of claim 1 wherein said electric nerve stimulation (ENS) therapy and said magnetic stimulation (MS) therapy are both administered to a same set of nerves of a brain.
9. The method of claim 1 wherein said electric nerve stimulation (ENS) therapy changes a polarization of synaptic membranes in a nuclei or center of the brain of the patient.
10. The method of claim 1 wherein said magnetic stimulation (MS) therapy changes a polarization of synaptic membranes in a nuclei or center of the brain of the patient.
11. The method of claim 1 wherein said MS therapy is applied to tissue remote from the brain of the patient.
12. The method of claim 1 wherein said magnetic stimulation (MS) therapy is administered to said patient after said electric nerve stimulation (ENS) therapy is administered to said patient.
13. The method of claim 1 wherein said magnetic stimulation (MS) therapy is administered to said patient before said electric nerve stimulation (ENS) technique is administered to said patient.
14. The method of claim 1 further comprising temporally alternating said administration of said electric nerve stimulation (ENS) therapy and said administration of said magnetic stimulation (MS) therapy a plurality of times.

15. The method of claim 1 wherein said electric nerve stimulation (ENS) therapy and said magnetic stimulation (MS) therapy are administered simultaneously.
16. The method of claim 1 wherein said magnetic stimulation (MS) therapy is administered to nuclear synaptic areas including cell bodies, dendrites, and pre-synaptic terminals where a membrane potential exists and an action potential does not exist.
17. The method of claim 1 wherein said electric nerve stimulation (ENS) therapy is administered until a desired clinical outcome is achieved, followed by said administering of said magnetic stimulation (MS) therapy for enhanced effectiveness.
18. The method of claim 1 wherein said magnetic stimulation (MS) therapy is administered until a desired clinical outcome is achieved, followed by said administering of said electric nerve stimulation (ENS) therapy for enhanced effectiveness.
19. The method of claim 6 wherein said magnetic field comprises a pulsed magnetic field.
20. The method of claim 6 wherein said magnetic field comprises an alternating magnetic field.
21. The method of claim 6 wherein said magnetic field comprises a steady magnetic field.
22. The method of claim 6 wherein said physiological response includes changes in electroencephalogram (EEG) activity of said brain.
23. The method of claim 6 wherein said selectively adapting said at least one parameter of said magnetic field results in changing said physiological response such that said change in said physiological response indicates a reduction in said symptoms.

24. The method of claim 6 wherein said at least one parameter of said magnetic field comprises a pulse width, a pulse repetition frequency, a magnetic intensity, and an orientation.
25. The method of claim 6 wherein said step of applying a magnetic field comprises:
- providing a magnetic generator to generate said magnetic field upon activation of said magnetic generator;
- setting at least one parameter of said magnetic generator, based on said symptoms; and
- stereotactically positioning a magnetic coil of said magnetic generator in relation to said brain such that said magnetic field becomes focused on a selected synaptic region of said brain to polarize said selected synaptic region in a predetermined manner upon activation of said magnetic generator.
26. The method of claim 6 wherein said step of monitoring said physiological response comprises contacting at least one electrode on the scalp of said patient to monitor electroencephalogram (EEG) changes of said brain.
27. A method of treating a neuropsychiatric disorder in a patient, said method comprising
- applying a magnetic field to the brain of said patient, and
- administering electric nerve stimulation (ENS) therapy to the brain of the patient.
28. The method of claim 27 wherein said magnetic field comprises a pulsed magnetic field.
29. The method of claim 27 wherein said magnetic field comprises an alternating magnetic field.

30. The method of claim 27 wherein said magnetic field comprises a steady magnetic field.
31. The method of claim 27 wherein said step of applying a magnetic field comprises producing a current within said brain which generates a motor seizure in said patient.
32. The method of claim 27 wherein said step of applying a magnetic field comprises producing a current within said brain without generating a motor seizure in said patient.
33. The method of claim 32 wherein said motor seizure is prevented by limiting said application of said magnetic field so as not to reach a motor area of said brain.
34. The method of claim 33 wherein said motor area of said brain comprises a motor cortex of said brain.
35. The method of claim 27 wherein said step of applying a magnetic field comprises producing a current within areas of said brain that do not include motor centers of said brain.
36. The method of claim 27 wherein said step of applying a magnetic field comprises producing an EEG seizure.
37. The method of claim 27 wherein said step of applying a magnetic field comprises producing an EEG seizure without causing a motor seizure.
38. The method of claim 27 wherein said step of applying a magnetic field comprises providing at least one magnetic coil for producing said magnetic field.

39. The method of claim 27 wherein said step of applying a magnetic field comprises providing at least one magnetic coil connected to a generator comprising capacitors, switching elements, and sensing elements.
40. The method of claim 39 wherein said generator is connected to an electrical power source.
41. The method of claim 27 wherein said step of applying a magnetic field comprises concentrating said magnetic field in certain brain synaptic regions by selectively orienting at least one magnetic coil with respect to said certain brain synaptic regions.
42. The method of claim 27 wherein said step of applying a magnetic field comprises concentrating said magnetic field in certain brain synaptic regions by selectively orienting at least two magnetic coils with respect to said certain brain synaptic regions.
43. The method of claim 27 wherein said step of applying a magnetic field comprises inducing a current within said brain that produces a polarization change within certain synaptic regions of said brain.
44. The method of claim 43 wherein said step of applying a magnetic field comprises providing a positively directed induced current to produce a positive polarization change (hyperpolarization).
45. The method of claim 43 wherein said step of applying a magnetic field comprises providing a negatively directed induced current to produce a negative polarization change (depolarization).
46. The method of claim 44 wherein said hyperpolarization causes a decrease in EEG frequency (synchronization) within said certain synaptic regions of said brain.

47. The method of claim 45 wherein said depolarization causes an increase in EEG frequency (desynchronization) within said certain synaptic regions of said brain.
48. The method of claim 43 wherein said step of inducing a current produces synaptic polarization changes that do not cause a nerve-firing threshold to be reached in said certain synaptic regions.
49. The method of claim 27 wherein said electric nerve stimulation (ENS) therapy comprises vagus nerve stimulation (VNS).
50. A system for providing therapeutic treatment of a neuropsychiatric disorder or other illness in a patient, said system comprising:
- a magnetic stimulation (MS) subsystem to generate a pulsed current waveform to produce a pulsed magnetic field to stimulate a first region within the brain of said patient;
 - an electric nerve stimulation (ENS) subsystem to generate electric signals to stimulate a second region within the brain of said patient; and
 - a computer-based switching subsystem coupled to said magnetic stimulation (MS) subsystem and said electric nerve stimulation (ENS) subsystem to select at least one of said magnetic stimulation (MS) subsystem and said electric nerve stimulation (ENS) subsystem for stimulation of the brain of the patient.
51. The system of claim 50 wherein said magnetic stimulation (MS) subsystem comprises:
- a configuration of switches and storage capacitors having an electrical input and an electrical output;

an electrical energy source coupled to said electrical input of said configuration; and

at least one magnetic coil coupled to said electrical output of said configuration.

52. The system of claim 50 wherein said electric nerve stimulation (ENS) subsystem comprises a vagus nerve stimulation (VNS) system.
53. The system of claim 50 further comprising a monitoring subsystem to monitor a physiological response of the brain of the patient to said electric signals and/or said pulsed magnetic field.
54. The system of claim 53 wherein said physiological response comprises electroencephalogram (EEG) changes of said brain.
55. The system of claim 50 further comprising a controller to control the parameters and operation of said system.
56. The system of claim 51 wherein said pulsed magnetic field is produced by charging said storage capacitors with energy from said electrical energy source, and discharging said energy from said storage capacitors into said at least one magnetic coil as said pulsed current waveform.
57. The system of claim 50 wherein said pulsed magnetic field produces a bi-phasic damped induced current within said first region of the brain of said patient.
58. The system of claim 50 wherein said pulsed magnetic field produces a poly-phasic damped induced current within said first region of the brain of said patient.
59. The system of claim 51 wherein said at least one magnetic coil comprises wound and insulated metallic wire in a molded plastic housing.

60. The system of claim 59 further comprising at least one electronic circuit and at least one temperature sensor within said molded plastic housing.
61. The system of claim 51 wherein said at least one magnetic coil is coupled to said configuration via at least one flexible high-power cable.
62. The system of claim 51 wherein said pulsed magnetic field produces synaptic polarizations in different regions of said brain of said patient depending on at least a size of said magnetic coil, a geometry of said magnetic coil with respect to said patient, and a magnetic field strength of said pulsed magnetic field.
63. The system of claim 51 wherein said switches comprise solid state thyristors to switch energy stored in said capacitors to said at least one magnetic coil in the form of said pulsed current waveform.
64. The system of claim 50 wherein said pulsed current waveform comprises one of monophasic pulses, symmetric biphasic pulses, and exponential decay biphasic pulses.
65. The system of claim 51 wherein a capacitance of said storage capacitors, a conductance of said at least one magnetic coil, and a resistance of said at least one magnetic coil are regulated to control a rise time and a decay time of each pulse of said pulsed current waveform.
66. The system of claim 51 wherein said at least one magnetic coil comprises a plurality of magnetic coils arranged in different spatial planes to focus said pulsed magnetic field to precise locations in deep synaptic structures within said brain of said patient.
67. The system of claim 51 wherein a central axis of said at least one magnetic coil is positioned perpendicular to an imaginary line defining a synaptic region of said brain of said patient.

68. The system of claim 51 wherein a central axis of said at least one magnetic coil is positioned parallel to an imaginary line defining a synaptic region of said brain of said patient.
69. The system of claim 50 wherein focusing of said pulsed magnetic field is aided by induced electric charges that occur naturally within said brain of said patient at synaptic membranes.
70. The system of claim 50 wherein focusing of said pulsed magnetic field is aided by selectively polarizing synaptic regions of said brain of said patient using said electric nerve stimulation (ENS) subsystem.
71. The system of claim 51 further comprising at least one transformer connected between said configuration and said at least one magnetic coil to increase a magnitude of said pulsed current waveform within said at least one magnetic coil.
72. The system of claim 51 further comprising a ferromagnetic material that is placed around said at least one magnetic coil to increase an effectiveness of said pulsed magnetic field.
73. The system of claim 50 wherein focusing of said pulsed magnetic field within said brain of said patient is aided by placing magnetic or paramagnetic material within synaptic regions of said brain.
74. The system of claim 73 wherein said magnetic or paramagnetic material is placed within said synaptic regions via injection into blood vessels.
75. The system of claim 73 wherein said magnetic or paramagnetic material is placed within said synaptic regions using an external magnetic device and visual monitoring techniques.
76. The system of claim 50 wherein said magnetic stimulation (MS) subsystem aids said electric nerve stimulation (ENS) subsystem by said pulsed magnetic

field acting at synaptic membranes within said brain of said patient to cause an enhanced polarization effect over that of using said ENS subsystem alone.

77. The system of claim 50 wherein magnetic stimulation acts on pathological or dysfunctional tissues or organs of the body to cause an enhanced polarization effect to control or prevent any illness affecting the body.
78. The system of claim 50 wherein magnetic stimulation aids electrical nerve stimulation (ENS) by acting on the brain or dysfunctional tissues or organs of the body to cause an enhanced polarization effect to control or prevent any illness affecting the brain or body.